

CLAIMS

1. A net list conversion method comprising:

a net list designation step of designating a net list to be subjected to detection of through current in a stationary state;

a net extraction step of extracting a net connected to a gate terminal of a MOS transistor from the detection target net list, and storing the extracted net in a extracted net database which is provided for each of MOS transistors having different threshold values; and

a resistor insertion step of inserting a resistor element having a unique resistor element name, between the extracted net that is connected to the gate terminal of the extracted MOS transistor and a power supply that is determined for each threshold value of the MOS transistor, and between the extracted net and a reference voltage, in the detection target net list, on the basis of the extracted net database that is provided for each of the MOS transistors having different threshold values.

2. A net list conversion method as defined in Claim 1 wherein said net extraction step comprises:

a MOS transistor detection step of detecting a MOS transistor in the detection target net list;

a net detection step of detecting a net connected to a gate terminal of the detected MOS transistor, and storing the detected

net in the extracted net database; and

a resistor element detection step of detecting a resistor element in the detected target net list, and storing a resistor element name of the detected resistor element in a resistor element name database.

3. A net list conversion method as defined in Claim 2 wherein said MOS transistor detection step checks whether a first character in each row included in the detection target net list is "M" or not, and determines that the corresponding row describes about a MOS transistor when the first character in the row is "M".

4. A net list conversion method as defined in Claim 2 wherein said net detection step comprises:

detecting, from a row determined as describing about a MOS transistor in the MOS transistor detection step, a net connected to the gate terminal of the MOS transistor;

determining a threshold value of the MOS transistor from a model name of the MOS transistor, said model name being indicated by a sixth character string in the row; and

storing the net that is connected to the gate terminal of the MOS transistor, in a database of the corresponding threshold value among the extracted net databases which are provided for the respective threshold values of the MOS transistor.

5. A net list conversion method as defined in Claim 2 wherein said resistor element detection step comprises:

checking whether a first character in each row included in the detection target net list is "R" or not, and determines that the corresponding row describes about a resistor element when the first character in the row is "R";

extracting a first character string in the row that is determined as describing about a resistor element, as a resistor element name of the resistor element; and

storing the extracted resistor element name in the resistor element name database.

6. A net list conversion method as defined in Claim 1 wherein said resistor insertion step comprises:

creating a new resistor element name to be a unique resistor element name by searching the resistor element name database;

adding a resistor element having the created new resistor element name into the net list, between a net that is stored in the extracted net database which is provided for each of MOS transistors having different threshold values and the power supply that is determined for each threshold value of the MOS transistor, and between the stored net and the reference voltage; and

adding the resistor element names of the added resistor

elements into the resistor element name database.

7. A net list conversion method as defined in Claim 1 further including:

an overlapping net deletion step of deleting a net that overlaps in each extracted net database, among the nets extracted in the net extraction step and stored in the extracted net database which is provided for each of MOS transistors having difference threshold values, and

said resistor insertion step inserting a resistor element having a unique resistor element name, between the net connected to the gate terminal of the MOS transistor and the power supply that is determined for each threshold value of the MOS transistor, and between the net and the reference voltage, in the detection target net list, on the basis of the extracted net database from which the overlapping net is deleted by the overlapping net deletion step.

8. A net list conversion method as defined in Claim 7 wherein said overlapping net deletion step comprises:

reading the extracted net database that is provided for each of MOS transistors having different threshold values;

rearranging the nets stored in the read extracted net database in lexicographical order; and

searching the rearranged extracted net database from the

beginning, and deleting a net that is identical to a net as a search target.

9. A net list conversion method as defined in Claim 1 further including a net number counting step of reading the extracted net database that is provided for each of MOS transistors having different threshold values, and counting, for each extracted net database, the number of nets included in the extracted net database.

10. A net list conversion method comprising:

- a net list designation step of designating a net list to be subjected to detection of through current in a stationary state;

- a sub-circuit replacement step of replacing a MOS transistor in the detection target net list with a sub-circuit according to a threshold value and type of the MOS transistor; and

- a sub-circuit addition step of adding, into the detection target net list, sub-circuit information of the sub-circuit with which the MOS transistor is replaced.

11. A net list conversion method as defined in Claim 10 further including a replaced transistor number counting step of counting the number of MOS transistors that are replaced with sub-circuits according to the threshold values and types of the MOS transistors by the sub-circuit replacement step.

12. A net list conversion method as defined in Claim 10 wherein said sub-circuit replacement step comprises:

detecting a MOS transistor in the detection target net list;

determining a threshold value of the MOS transistor from a model name of the MOS transistor, said model name being indicated by a sixth character string in a row that describes about the detected MOS transistor;

replacing the description of the detected MOS transistor with a sub-circuit according to the threshold value and type of the MOS transistor; and

adding "X" at the top of a first character string in a row of the sub-circuit with which the MOS transistor is replaced, and describing, in the row, connection information comprising "drain terminal", "gate terminal", "source terminal", and "bulk terminal" and parameter information comprising "W:channel width", "L:channel length", "M:multiplier", which correspond to second, third, fourth and fifth character strings of the description of the MOS transistor before being replaced with the sub-circuit.

13. A net list conversion method as defined in Claim 10 wherein said sub-circuit addition step adds the sub-circuit information to the detection target net list; and

said sub-circuit information includes a MOS transistor according to the threshold value and type of the MOS transistor

that is replaced with the sub-circuit, and resistor elements that are inserted between the gate terminal of the MOS transistor and a power supply according to the threshold value of the MOS transistor, and between the gate terminal of the MOS transistor and a reference voltage.

14. A net list conversion method comprising:

- a net list designation step of designating a net list to be subjected to detection of through current in a stationary state;

- a first net extraction step of extracting a net connected to a gate terminal of a MOS transistor from the detection target net list, and storing the extracted net in an extracted net database which is provided for each of MOS transistors having different threshold values;

- a second net extraction step of extracting a net connected to an input terminal of a sub-circuit from the detection target net list, and storing the extracted not in an extracted net database which is provided for each of the MOS transistors having different threshold values; and

- a resistor insertion step of inserting a resistor element having a unique resistor element name, between the net extracted in the first net extraction step and the second net extraction step and a power supply, and between the extracted net and a reference voltage, in the detection target net list, on the basis of the extracted net database that is provided for each of the

MOS transistors having different threshold values.

15. A net list conversion method as defined in Claim 14 wherein said second net extraction step checks whether a first character in each row included in the detection target net list is "X" or not, and determines that the corresponding row describes about a sub-circuit when the first character in the row is "X".

16. A net list conversion method as defined in Claim 14 further including:

an overlapping net deletion step of deleting a net that overlaps in each extracted net database, among the nets extracted in the first net extraction step and the second net extraction step and then stored in the extracted net database which is provided for each of MOS transistors having difference threshold values, and

said resistor insertion step of inserting a resistor element having a unique resistor element name, between the net extracted in the first net extraction step and the second net extraction step and the power supply, and between the extracted net and the reference voltage, in the detection target net list, on the basis of the extracted net database from which the overlapping net is deleted in the overlapping net deletion step.

17. A net list conversion method as defined in Claim 16 further

including a net number counting step of reading the extracted net database that is provided for each of the MOS transistors having different threshold values, and counting the number of nets included in the extracted net database, for each extracted net database.

18. A net list conversion method as defined in Claim 14 further including:

a comparison step of comparing the sub-circuit extracted in the second net extraction step with a sub-circuit database in which specific sub-circuit is entered;

said resistor insertion step

inserting a resistor element having a unique resistor element name, between the net extracted in the first net extraction step and the power supply, and between the extracted net and the reference voltage, in the detection target net list, on the basis of the extracted net database that is provided for each of the MOS transistors having different threshold values, and

inserting a resistor element having a unique resistor element name, between a net other than a net included in a sub-circuit that is determined as being entered in the sub-circuit database in the comparison step among the sub-circuits extracted in the second net extraction step and the power supply, and between the net and the reference voltage, in the detection

target net list.

19. A net list conversion apparatus comprising:

a net list designation unit for designating a net list to be subjected to detection of through current in a stationary state;

a net extraction unit for extracting a net connected to a gate terminal of a MOS transistor from the detection target net list, and storing the extracted net in a extracted net database which is provided for each of MOS transistors having different threshold values; and

a resistor insertion unit for inserting a resistor element having a unique resistor element name, between the extracted net that is connected to the gate terminal of the extracted MOS transistor and a power supply that is determined for each threshold value of the MOS transistor, and between the extracted net and a reference voltage, in the detection target net list, on the basis of the extracted net database that is provided for each of the MOS transistors having different threshold values.

20. A net list conversion apparatus as defined in Claim 19 further including:

an overlapping net deletion unit for deleting a net that overlaps in each extracted net database, among the nets extracted by the net extraction unit and stored in the extracted net database which is provided for each of the MOS transistors having

difference threshold values, and

said resistor insertion unit inserting a resistor element having a unique resistor element name, between the net connected to the gate terminal of the MOS transistor and the power supply that is determined for each threshold value of the MOS transistor, and between the net and the reference voltage, in the detection target net list, on the basis of the extracted net database from which the overlapping net is deleted by the overlapping net deletion unit.

21. A net list conversion apparatus as defined in Claim 19 further including a net number counting unit for reading the extracted net database that is provided for each of MOS transistors having different threshold values, and counting, for each extracted net database, the number of nets included in the extracted net database.

22. A net list conversion apparatus comprising:

a net list designation unit for designating a net list to be subjected to detection of through current in a stationary state;

a sub-circuit replacement unit for replacing a MOS transistor in the detection target net list with a sub-circuit according to a threshold value and type of the MOS transistor; and

a sub-circuit addition unit for adding, into the detection target net list, sub-circuit information of the sub-circuit with

which the MOS transistor is replaced.

23. A net list conversion apparatus as defined in Claim 22 further including a replaced transistor number counting unit for counting the number of MOS transistors that are replaced with sub-circuits according to the threshold values and types of the MOS transistors by the sub-circuit replacement unit.

24. A net list conversion apparatus comprising:

a net list designation unit for designating a net list to be subjected to detection of through current in a stationary state;

a first net extraction unit for extracting a net connected to a gate terminal of a MOS transistor from the detection target net list, and storing the extracted net in an extracted net database which is provided for each of MOS transistors having different threshold values;

a second net extraction unit for extracting a net connected to an input terminal of a sub-circuit from the detection target net list, and storing the extracted not in an extracted net database which is provided for each of the MOS transistors having different threshold values; and

a resistor insertion unit for inserting a resistor element having a unique resistor element name, between the net extracted by the first net extraction unit and the second net extraction unit and a power supply, and between the extracted net and a

reference voltage, in the detection target net list, on the basis of the extracted net database that is provided for each of the MOS transistors having different threshold values.

25. A net list conversion apparatus as defined in Claim 24 further including:

an overlapping net deletion unit for deleting a net that overlaps in each extracted net database, among the nets extracted by the first net extraction unit and the second net extraction unit and then stored in the extracted net database which is provided for each of MOS transistors having difference threshold values, and

said resistor insertion unit for inserting a resistor element having a unique resistor element name, between the net extracted by the first net extraction unit and the second net extraction unit and the power supply, and between the extracted net and the reference voltage, in the detection target net list, on the basis of the extracted net database from which the overlapping net is deleted by the overlapping net deletion unit.

26. A net list conversion apparatus as defined in Claim 24 further including a net number counting unit for reading the extracted net database that is provided for each of the MOS transistors having different threshold values, and counting the number of nets included in the extracted net database, for each

extracted net database.

27. A stationary through current detection method comprising:

a net list conversion step of converting a net list to be subjected to detection of through current in a stationary state, by using a net list conversion method according to any of Claims 1, 10, and 14;

a DC analysis step of subjecting a post-conversion net list obtained in the net list conversion step to DC analysis to obtain a DC analysis result; and

a transistor search step of searching for a MOS transistor in which through current might occur, in the detection target net list, on the basis of the DC analysis result obtained in the DC analysis step.

28. A stationary through current detection method as defined in Claim 27 wherein said transistor search step comprising:

determining, on the basis of the DC analysis result, as to whether a current $|i_{ds}|$ that flows in a MOS transistor in the detection target net list exceeds a predetermined current threshold value I_{th} or not; and

storing a MOS transistor in which the current $|i_{ds}|$ exceeds the current threshold value I_{th} , as a current through MOS transistor, in a current through MOS transistor database.

29. A stationary through current detection method comprising:

a net list conversion step of converting a net list to be subjected to detection of through current in a stationary state, by using a net list conversion method according to any of Claims 9, 11, and 17;

a DC analysis step of subjecting a post-conversion net list obtained in the net list conversion step to DC analysis to obtain a DC analysis result;

a transistor search step of searching for a MOS transistor in which through current might occur, in the detection target net list, on the basis of the DC analysis result obtained in the DC analysis step; and

a total through current calculation step of calculating total through current in the detection target net list.

30. A stationary through current detection method as defined in Claim 29 wherein said total through current calculation step subtracts $(\text{number of extracted nets} * ((\text{power supply voltage} - \text{reference voltage}) / (\text{inserted resistance value} * 2)))$ or $(\text{number of replaced transistors} * ((\text{power supply voltage} - \text{reference voltage}) / (\text{inserted resistance value} * 2)))$ from a current which flows between the power supply that is determined for each threshold value of the MOS transistor and the reference voltage, on the basis of the DC analysis result, and the number of nets included in the extracted net database or the number of MOS

transistors replaced with sub-circuits.

31. A stationary through current detection method comprising:

a net list conversion step of converting a net list to be subjected to detection of through current in a stationary state, by using a net list conversion method according to any of Claims 1, 10, and 14; and

a histogram formation step of subjecting a post-conversion net list obtained in the net list conversion step to DC analysis, and forming a histogram relating to through currents $|I_{ds}|$ in MOS transistors in the detection target net list on the basis of the DC analysis result.

32. A stationary through current detection apparatus comprising:

a net list conversion unit for converting a net list to be subjected to detection of through current in a stationary state, by using a net list conversion apparatus according to any of Claims 19, 22, and 24;

a DC analysis unit for subjecting a post-conversion net list obtained by the net list conversion unit to DC analysis to obtain a DC analysis result; and

a transistor search unit for searching for a MOS transistor in which through current might occur, in the detection target net list, on the basis of the DC analysis result obtained by the DC analysis unit.

33. A stationary through current detection apparatus comprising:

a net list conversion unit for converting a net list to be subjected to detection of through current in a stationary state, by using a net list conversion apparatus according to any of Claims 21, 23, and 26;

a DC analysis unit for subjecting a post-conversion net list obtained by the net list conversion unit to DC analysis to obtain a DC analysis result;

a transistor search unit for searching for a MOS transistor in which through current might occur, in the detection target net list, on the basis of the DC analysis result obtained by the DC analysis unit; and

a total through current calculation unit for calculating total through current in the detection target net list.

34. A stationary through current detection apparatus comprising:

a net list conversion unit for converting a net list to be subjected to detection of through current in a stationary state, by using a net list conversion apparatus according to any of Claims 19, 22, and 24; and

a histogram formation unit for subjecting a post-conversion net list obtained by the net list conversion unit to DC analysis, and forming a histogram relating to through currents $|I_{ds}|$ in MOS transistors in the detection target net list on the basis of the

DC analysis result.

35. A net list conversion program for making a computer execute a net list conversion process for a net list to be subjected to detection of through current in a stationary state, said net list conversion program comprising:

a net list designation step of designating the net list;

a net extraction step of extracting a net connected to a gate terminal of a MOS transistor from the detection target net list, and storing the extracted net in a extracted net database which is provided for each of MOS transistors having different threshold values; and

a resistor insertion step of inserting a resistor element having a unique resistor element name, between the extracted net that is connected to the gate terminal of the extracted MOS transistor and a power supply that is determined for each threshold value of the MOS transistor, and between the extracted net and a reference voltage, in the detection target net list, on the basis of the extracted net database that is provided for each of the MOS transistors having different threshold values.

36. A net list conversion program for making a computer execute a net list conversion process for a net list to be subjected to detection of through current in a stationary state, said net list conversion program comprising:

a net list designation step of designating the net list;
a sub-circuit replacement step of replacing a MOS transistor in the detection target net list with a sub-circuit according to a threshold value and type of the MOS transistor; and
a sub-circuit addition step of adding, into the detection target net list, sub-circuit information of the sub-circuit with which the MOS transistor is replaced.

37. A net list conversion program for making a computer execute a net list conversion process for a net list to be subjected to detection of through current in a stationary state, said net list conversion program comprising:

a net list designation step of designating the net list;
a first net extraction step of extracting a net connected to a gate terminal of a MOS transistor from the detection target net list, and storing the extracted net in an extracted net database which is provided for each of MOS transistors having different threshold values;

a second net extraction step of extracting a net connected to an input terminal of a sub-circuit from the detection target net list, and storing the extracted not in an extracted net database which is provided for each of the MOS transistors having different threshold values; and

a resistor insertion step of inserting a resistor element having a unique resistor element name, between the net extracted

in the first net extraction step and the second net extraction step and a power supply, and between the extracted net and a reference voltage, in the detection target net list, on the basis of the extracted net database that is provided for each of the MOS transistors having different threshold values.

38. A stationary through current detection program for making a computer execute a stationary through current detection process for a net list to be subjected to detection of through current in a stationary state, said stationary through current detection program comprising:

- a net list conversion step of converting a net list to be subjected to detection of through current in a stationary state, by using a net list conversion method according to any of Claims 1, 10, and 14;

- a DC analysis step of subjecting a post-conversion net list obtained in the net list conversion step to DC analysis to obtain a DC analysis result; and

- a transistor search step of searching for a MOS transistor in which through current might occur, in the detection target net list, on the basis of the DC analysis result obtained in the DC analysis step.

39. A stationary through current detection program for making a computer execute a stationary through current detection process

for a net list to be subjected to detection of through current in a stationary state, said stationary through current detection program comprising:

- a net list conversion step of converting a net list to be subjected to detection of through current in a stationary state, by using a net list conversion method according to any of Claims 9, 11, and 17;

- a DC analysis step of subjecting a post-conversion net list obtained in the net list conversion step to DC analysis to obtain a DC analysis result;

- a transistor search step of searching for a MOS transistor in which through current might occur, in the detection target net list, on the basis of the DC analysis result obtained in the DC analysis step; and

- a total through current calculation step of calculating total through current in the detection target net list.

40. A stationary through current detection program for making a computer execute a stationary through current detection process for a net list to be subjected to detection of through current in a stationary state, said stationary through current detection program comprising:

- a net list conversion step of converting a net list to be subjected to detection of through current in a stationary state, by using a net list conversion method according to any of Claims

1, 10, and 14; and

a histogram formation step of subjecting a post-conversion net list obtained in the net list conversion step to DC analysis, and forming a histogram relating to through currents $|I_{ds}|$ in MOS transistors in the detection target net list on the basis of the DC analysis result.